an angle of about 65-70°C and the tail is twisted. It is possible, though unlikely, that water deficiency could have caused the deformation as has been described for chelonian embryo by Lynn and Ullrich (1950). However, fortyone eggs hatched and produced normal hatchlings. Seven fullgrown embryos failed to hatch due to some abnormality in the neck portion which was very thin. Sixty eggs which failed to hatch were apparently infertile.

Preliminary work, carried out by Bustard indicated that eggs dessicated rapidly when water was not available in the external medium. Here, rain was allowed to fall over the nest to keep the nest slight damp by which the nest can maintain correct temperature by the decomposition of the nesting material. Maximum sunshine was allowed to fall on the nest. The incubation period being in the rainy season it was hard to maintain equal temperature all the time. However, Bustard noted that eggs which had lost approximately 20% of their weight as result of dessication still produced normal hatchlings.

The deformation in both the neck and the tail may be due to high temperatures or may be due to the fluctuation of the temperature at the time of incubation. A detailed study of the water relationship of crocodile eggs of different developmental stages, would reveal the actual cause of deformation.

S. K. KAR

RESEARCH SCHOLAR,
SALT WATER CROCODILE RESEARCH
AND CONSERVATION PROJECT,
DANGAMAL-754 220, ORISSA,
October 16, 1978.

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13. SEXUAL ATTRACTION OF A WILD MUGGER (*CROCODYLUS PALUSTRIS* LESSON) TOWARD CAPTIVE MUGGERS

(*With three text-figures*)

Gharial Research and Conservation Unit (GRACU) is situated besides the Satkoshia Gorge of River Mahanadi. The Unit has several enclosure-sets of rearing pools for the gharial (*Gavialis gangeticus*). One such set (RP in Fig. 1 and 2) has a large pool (4m × 4m × 1m) and two small pools (2m × 2m × 0.3m). This enclosure (hence forth to be called as the "Mugger enclosure") is situated at the end of the Project complex; the nearest enclosure, called the Research Pool, being situated at a distance of about 35 metres.

During collection of data for this paper the two smaller pools of the Mugger enclosure

had one mugger each, and the larger pool had three muggers, all male and hatched during the second and third weeks of April, 1975. The muggers measured 138.0 cm to 188.0 cm and weighed 19.1 kg to 38.2 kg on 2-2-78. Usually the pools are thoroughly cleaned once a week, the washings coming out through underground pipes, enter the river.

Close to the mugger enclosure river Mahanadi flows down from south-west. The location of the enclosure in relation to the river (Fig. 3) is shown in Fig. 1 and Fig. 2. The photograph in Fig. 3 has been taken by standing on the river bank in line with the mugger enclosure.

Satkoshia Gorge has three individually identifiable muggers of unknown sex measuring 2.0 to 3.0 m in total length. The Gorge is a 22.4 km stretch of the river, measuring 300-700 m in width. Although no nest has been collected during four consecutive years of observations from 1975 to 1978 breeding seasons, at least one of these muggers is believed to be breeding since mugger hatchlings have been observed during 1976 and 1977. Every year after the flood at least one of the resident wild muggers, the largest of all, is known to frequent or inhabit a tunnel in the river bank. The tunnel used during post-flood season of 1975 had collapsed in 1976; so the mugger had excavtaed a new tunnel on the opposite bank. This tunnel was also used during 1977. The tunnel measured about a metre in height near its entrance; but the length could not be

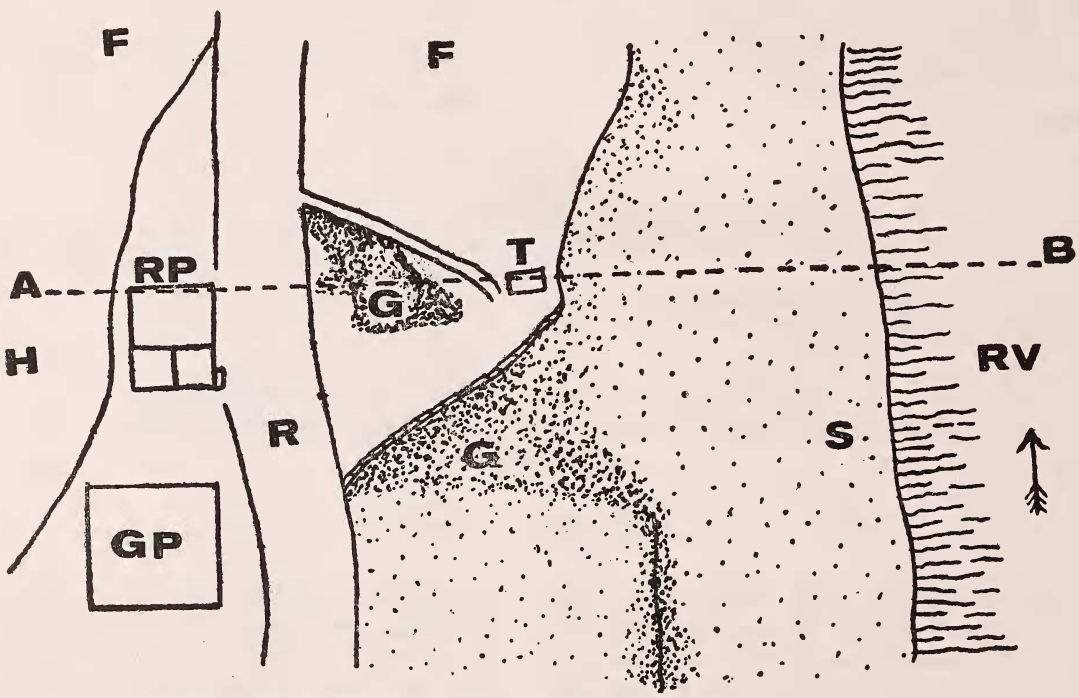

Fig. 1. Ground plan of GRACU near the Mugger enclosure and the adjacent River Mahanadi. A-B = Line of section shown in Fig. 2, F = forest, G = old gully partly filled in, GP = Gharial (Research) Pool, H = hill, R = road, RP = Rearing pool (Mugger enclosure), RV = river, S = sand, T = temple (area: 3 m × 2 m; height 1.5 m above the ground).

assessed properly since a bamboo measuring about 6 m was not adequate to reach the rear end of the excavation. We believe, perhaps the mugger lays her eggs in this tunnel.

However, there are ten trained guards to keep records on the movement of these muggers and the gharials in the gorge. The movement of one of these wild muggers, which measures about 2.8 m in total length, is the purview of the present paper.

Observations

When the water level in the gorge was +109-131 cm above the datum, the mugger under discussion was located once at 12.0 km (28.9.77) and 5.2* km (29.9.77) (the asterisk mark shows that the location is on the right bank when viewed from downstream) from the foot of the gorge; and when the level was 35 cm above the datum it was again located at 12.0 km on 11.11.77.

During December and January, when the water level was from +58.0 cm to –2.0 cm in relation to the datum, the mugger was located near GRACU on a total of four (20th, 25th, 26th and 30th) and seven (9th, 11th, 21st, 22nd, 23rd, 26th and 27th) days respectively. The precise location of its appearance is almost in line with the enclosure (RP: Fig. 1 and 2), about 10 m downstream from the point where the washings from the enclosure enter the river. On these days the mugger is located in shallow water before 2-3 hours of sunrise. When human activities at the Unit begin the mugger moves to mid-stream and surfaces for some time. After about two hours of sunrise our fishermen supplying fish to the Unit return from their overnight fishing and camp at their regular camping site (Fig. 3) which exactly corresponds to the site where the mugger shows up in the early morning. These fishermen leave their camping site at about 4.00 in the afternoon, when the mugger is again seen, on most of the observation-days, at about 0-100 m downstream from the camping site.

From 9th February to 11th February, 1978 the mugger was sighted everyday in the morning and in the evening. On 12.2.78 morning there was an U-shaped track on the sand upto 3 m on the bank from water. The height of the bank from the water was sharply 50 cm.

From this date the camping site of the fishermen was shifted to the other bank of the river. Only at the time of fish-supply they kept their boat at about 200 m upstream the previous site. All the bamboo poles used to keep the nets etc. were removed from the site

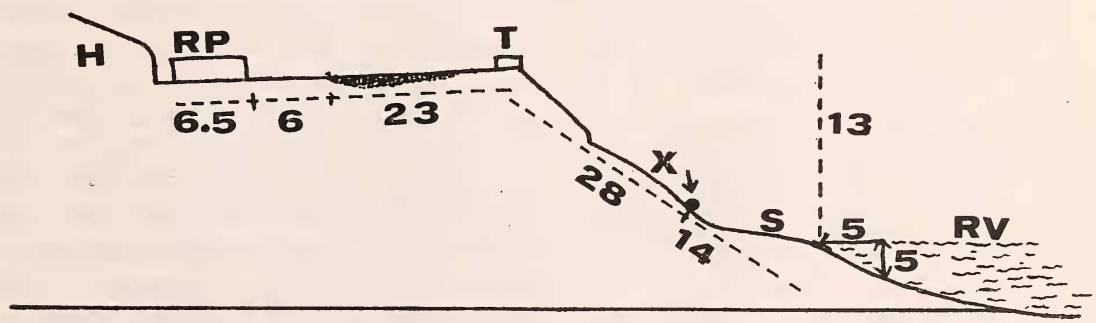

Fig. 2. Cross section of Fig. 1 along A-B. The numerals indicate distances in metres. X = see text, other abbreviations = as in Fig. 1.

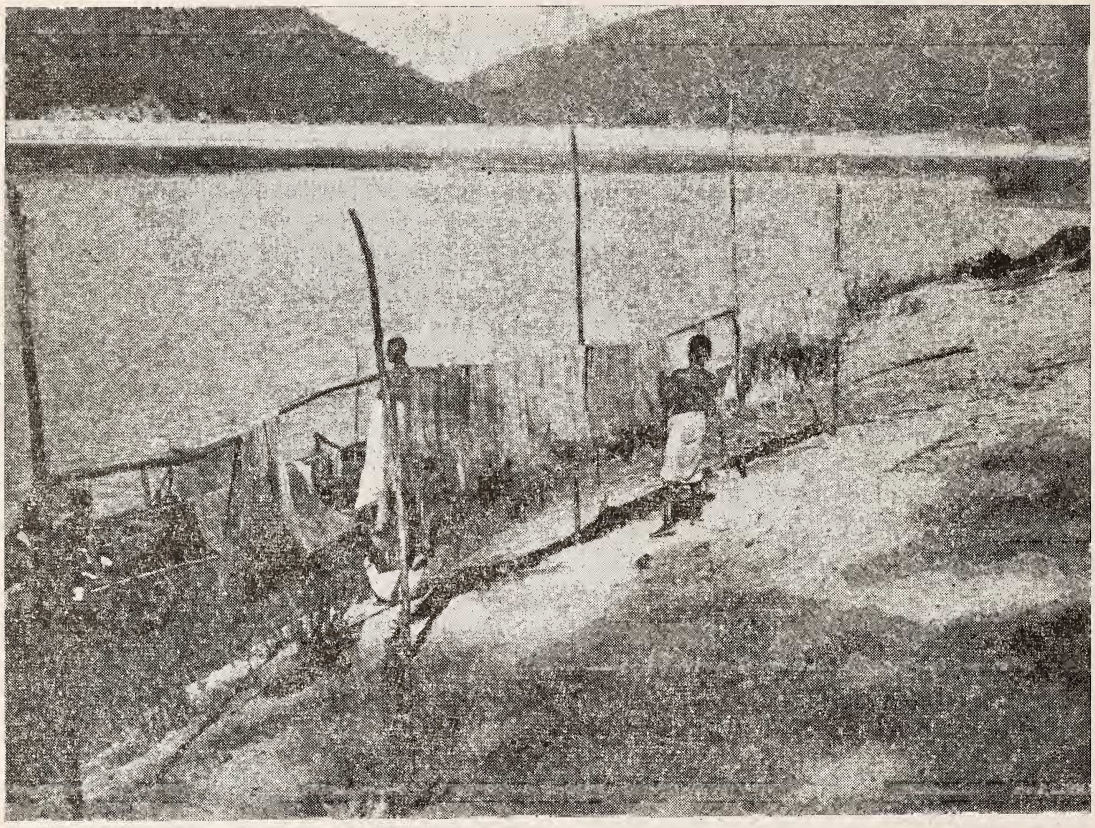

Fig. 3. Photograph showing the river bank down the Mugger enclosure at GRACU. This bank was used by the fishermen of GRACU to camp during the day. Washings from the Mugger enclosure enter the river approximately near the bamboo pole at the rear end of the photograph; and the wild mugger (see text) showed up almost near the first bamboo pole.

and the bank was restored to its normal.

On 12.2.78 afternoon and 13.2.78 the mugger could not be seen any where. But on 14.2.78 morning tracks were seen at the same place on the bank, but leading to the point 'X' (Fig. 2) where there was a heap of dried cut-down *Lantana* branches. Following this observation, the bank upto the temple (Figs. 1, 2) was cleaned from all debris.

On 14.2.78 afternoon and 15.2.78 the mugger was again secretive and it could not be located. On 16.2.78 morning at about 5.30 it was seen lying on the bank at the usual place of its appearance. Upon noticing our activities it entered water. When we went to the bank, we saw the emerging and returning tracks in single file upto a distance of about 14 m from water, after which there were numerous zigzag tracks. A track leading up and down the slope between 'X' and the temple was also marked. No track could be seeen between the temple and the enclosure. The ground in this area was hard and thus it was not possible to know if at all the mugger had moved through this region.

Subsequent to this observation the mugger

was never again sighted near GRACU. GRACU is about 17.2* km up the foot of the gorge. Later sightings were at 15.0 Km (22.2.78), 9.0* Km (24.2.78), 6.4 Km (24.3.78) and 11.2 Km (19.4.78). During February to April, 1978 the water level was +5.0 to –12.0 cm in relation to the datum.

Discussion

Dharmakumarsinhji (1947) observed mating in *C. palustris* on the 19th March. But David (1970) records mating in captivity in December-January and nesting in March-April. Acharjyo & Mishra (1976) observed in a captive *C. palustris* on 11.6.74 but later discovered the eggs to be infertile. Whitaker & Whitaker (1976) observe that *C. palustris* mates between January and March and the eggs are laid after about two months of mating.

In the foregoing account the behaviour of the wild mugger, 2.8 m in size, toward male captives, 1.8 m in size, was recorded at GRACU during December to mid-February. Constant showing up of the wild mugger, believed to be a female, near the shore down the mugger enclosure of GRACU, and her movement to close quarters of the enclosure suggest that she was attempting to reach the male muggers in captivity. The last attempt was made on the night of 15.2.78. Probably during this attempt she became sure that it was not possible to reach the male captives. This behaviour of the wild mugger toward the male captives suggest that she was trying to fulfil her mating urge. The period during which these observations were made correspond to the mating season of the mugger, reported earlier.

Gharial Research and
Conservation Unit,
Tikerpada-759122, Orissa,
June 22, 1978.

Interestingly, the wild mugger did not attempt to approach any of the other five enclosures having gharials and muggers of comparable age. One of the enclosures had seven female muggers and a male mugger of similar age but measuring only 72.0 cm to 139.4 cm and weighing 1.7 kg to 11.6 kg on 4.2.78. The washings of this enclosure also enter the river but at about 200 metres upstream from the point where the washings from the "Mugger enclosure" enter the river. This suggests that the wild mugger knew that the "Mugger enclosure" was housing sexually mature males. This inference draws up another conclusion on the record growth of captive muggers at GRACU. The muggers at GRACU under discussion were only two years and ten months old in February 1978 but had reached a length of 1.3 m to 1.8 m. The five muggers housed in the Mugger enclosure had grown fast among all-total thirteen muggers reared in captivity at GRACU.

Probably the cue which might have directed the wild mugger to know the location of the captive males were the washings from the enclosure entering the river, and the night time activities of the males, which include fights with loud sounds. It is interesting to note that the mugger was never sighted upstream of the point where the washings of the Mugger enclosure enter the river.

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LALA A. K. SINGH